Regional variation in prescription of psychotropic drugs and the factors behind in Norway

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Abstract

In Norway, consumption of psychotropic drug is increasing concomitant with huge variations across the counties. The main purpose of this research is to analyze the regional variation of consumption of psychotropic drug and identify the responsible factors for these variations. Using eight-years, 2004-2011, panel data analysis techniques for 19 counties, we provided fixed effect model to analyze the effect of some selective explanatory variables and different counties on the use of psychotropic drug. Our main result shows that consumption of psychotropic drug responded positively with higher education, higher population density, taking social assistance, age group 35-44, age group 45-69, age group 70-79, and age group 80+ and negatively responded with higher temperature, non-Norwegian ethnicity, GP density, and unemployment rate. We also found a clear north south difference with respect to psychotropic drug consumption. People living in Southern part of Norway consumed more psychotropic drug than those live in the Northern part.

Key words: psychotropic drug, regional variation, panel data, fixed effect model

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List of Acronyms

ATC: Anatomical therapeutic chemical classification system

AX: Anxiolytics

BZD(s): Benzodiazepine(s), ATC code: N05BA or N05CD

CMD: Common mental disorders

CNS: Central nervous system

COV: Coefficient of variation

DDD: Defined daily dose

DID: Defined daily dose per 1000 inhabitants per day

EQ: Extremal quotient

GP: General practitioner

HY: Hypnotics

NorPD: Norwegian Prescription Database

OLS: Ordinary Least Square

SSRI: Selective serotonin reuptake inhibitor

WHO: World Health Organization

Z-hypnotic(s): Benzodiazepine related hypnotic(s), ATC code: N05CF

1 Introduction

Number of persons who had at least one prescription is increasing in Norway with the total population. Between 2004 and 2011 the percentage of people who took at least one prescription drug increased almost14 percent whilst the total population of Norway increased nearly 7 percent that is a sign of growing sickness. By the sexual split, 76.41 percent women had at least one prescription at 2010 where 63.04 percent male had it (NorPD). Drug used for nervous system (group N under ATC) has emerged as a 2nd largest consumed drug after cardiovascular system (group C under ATC) in Norway according to the DDD per 1000 inhabitants per day (DID) (NorPD). In 2004, total consumption of drugs for nervous system was 154.34 DID which increased to 195.79 DID by 2011 (NorPD).

Among all the prescribed drugs for nervous system, three drugs, antidepressant, anxiolytics, and hypnotics and sedatives, are most consumed drugs in Norway. ``Anxiolytic drugs are agents that alleviate anxiety, tension, and anxiety disorders, promote sedation and have a calming effect without affecting clarity of consciousness`` (Hausken 2010). In Norway most commonly used anxiolytics are benzodiazepines (BZDs) (Rønning 2010). ``Hypnotics and sedatives are used to induce drowsiness or sleep or to reduce psychological excitement or anxiety`` (Hausken 2010). Main two drug groups for Hypnotics and sedatives (insomnia) in Norway are BZD related hypnotics (z hypnotics) and BZDs (Rønning 2010). ``Antidepressants are mood-stimulating drugs used in the treatment of depressive disorders`` (Hausken 2010). Selective serotonin reuptake inhibitors (SSRIs) are the most used antidepressant drugs (two-thirds) in Norway (Rønning 2010). By 2011, about 59 percentage of the total consumed nervous system drugs were these three drugs. Total consumption of these three drugs experienced an average annual increase in 1.95% between 2004 and 2011. Total consumption of these three drugs was about 104 DID in 2004, and increased to 116 DID by 2011 (NorPD). Aggregate value of these three drugs used as psychotropic drug in this study.

Norway is divided into 19 counties (fylker) that are Akershus, Aust-Agder, Buskerud, Finmark, Hedmark, Hordaland, Møre og Romsdal, Nordland, Nord-Trøndelag, Oppland, Oslo, Rogaland, Sogn og Fjordane, Sør-Trøndelag, Telemark, Troms, Vest-Agder, Vestfold, and Østfold and there are large differences in prescription of psychotropic drugs among the counties. Østfold was

the highest consumed aggregate psychotropic drugs (antidepressant, anxiolytics, and hypnotics and sedatives), DID 148.31, where Troms was the lowest by 83.60 DID in 2011 (NorPD). In reference of anxiolytics drug, Telemark consumed 25.25 DID which was the highest among the counties while Sogn og Fjordane consumed only 9.59 DID in 2011 (NorPD). Consumption of antidepressant drug among the counties also vary enormously, highest consumed by Østfold (74.79 DID) and lowest by Troms (37.60 DID) in 2011 (NorPD). On the other hand Aust-Agder and Finmark were the two extreme user of hypnotics and sedatives drug use among the different counties in 2011. Aust-Agder was highest user of hypnotics and sedatives drug by 58.54 DID and Finmark was the lowest by 30.75 DID (NorPD). Consumption of different psychotropic drugs (aggregate and separately) by the highest user (county) is almost double than lowest user, which ensure the huge difference in prescription of psychotropic drugs use among the different counties in Norway.

Objectives and research question of the study:

The objective of this study is to analyze the prescription of different psychotropic drugs in different counties in Norway from 2004 until 2011 based on different socio economic variables and find out the main reasons of regional variations in prescription of different psychotropic drugs. In that case the research question is:

Which factors are responsible for the regional variation in prescription of psychotropic drugs use in Norway?

To answer the research question this study used econometric estimation and graphical information system (GIS) where different socio economic variables and different counties were the key variables. A fixed effect panel data model is used for the analysis of psychotropic drug use. Hausman test also conducted for the choice whether fixed effects or random effect is fit for this data set. Finally this study used GIS to show the regional variation of psychotropic drug use after the econometric analysis.

Organizations of the study:

The remainder of this study is organized as follows. Section two provides some background of the nervous system drugs, importance of three drugs (antidepressant, anxiolytics, and hypnotics and sedatives) as psychotropic drug, and the use of different psychotropic drugs (aggregate and separately) in different counties in Norway. A review of relevant literature is provided in section three. Section four defines the variables to be used and develops the methodology that is to be used for the analysis in section five. The results of the analysis are presented in section five and the insights are discussed in section six. Finally, section seven provides a conclusion and further develops policy implications. There is a section that addresses the limitations of the study.

2 Background

2.1 Consumption of nervous system drugs (Group N under ATC)

By 2011, nervous system drugs have become second largest consumed drug under ATC drug groups in Norway and the consumption trend of this drug is upward which demands further attention.

Figure 1: Trend of Nervous system (Group N under ATC) drugs use in Norway in 2004-2011

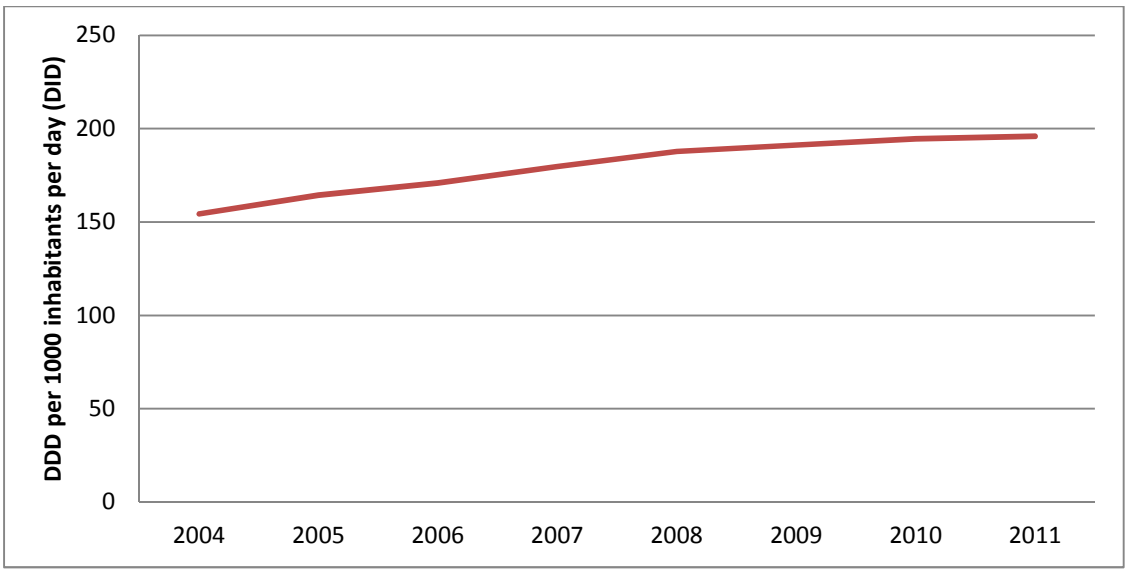


Figure 1 represents the total consumption of drugs used for nervous system (group N) by DID between the periods 2004-2011. In every year between 2004 and 2011, nervous system drugs consumption increased but steadily and finally it experienced 195.79 DID in 2011 as second largest consumed group under ATC in Norway. Between 2004 and 2011, drugs for nervous system increased by nearly 41 DID by average 3.48% growth in each year.

2.2 Importance of three drugs, antidepressant, anxiolytics, and hypnotics and sedatives, as psychotropic drug

The use of psychotropic drugs is increasing in Norway. Antidepressant, anxiolytics, and hypnotics and sedatives are most used psychotropic drugs there by contributing more than half of the total psychotropic drugs.

Table 1: Consumption of antidepressant, anxiolytics, hypnotics and sedatives, and aggregate of three drugs (as psychotropic drug) by DDD per 1000 inhabitants per day (DID) and % share of total drugs for nervous system (group N under ATC)

Year	Antidepressant		Anxiolytics		Hypnotics and sedatives		Aggregate of three drugs	
	DID	Share	DID	Share	DID	Share	DID	Share
2004	49.05	31.78	19.16	12.42	36.29	23.51	104.50	67.71
2005	49.23	29.95	19.67	11.97	39.33	23.93	108.24	65.84
2006	50.01	29.27	19.38	11.34	41.21	24.12	110.61	64.73
2007	52.33	29.12	19.32	10.75	43.36	24.12	115.01	63.99
2008	53.32	28.40	19.52	10.40	44.76	23.84	117.60	62.64
2009	53.35	27.90	19.20	10.04	45.27	23.68	117.82	61.61
2010	54.61	28.08	18.31	9.41	45.07	23.17	117.98	60.66
2011	55.28	28.23	16.90	8.63	44.22	22.58	116.40	59.45

Source: NorPD

Consumption of nervous system drugs is highly dependent on three drugs, antidepressant, anxiolytics, and hypnotics and sedatives. The contribution of these three drugs in total nervous system drugs consumption was about 59 percent in 2011 where individual share of antidepressant, anxiolytics, and hypnotics and sedatives was nearly 28%, 9%, and 23%, respectively. But in 2004, the share of aggregate three drugs, antidepressant, anxiolytics, and hypnotics and sedatives was almost 68%, 32%, 12%, and 24%, respectively. Even though the share of these drugs decreased from 2004 to 2011, the total consumption increased except anxiolytics. Antidepressant drug consumption increased by almost 6 DID while hypnotics and sedatives increased by 8 DID and anxiolytics decreased by almost 2 DID. In reference of aggregate of these three drugs (psychotropic), total consumption was increased by almost 12 DID between 2004 and 2011.

2.3 Consumption of psychotropic (Aggregate three drugs), antidepressant, anxiolytics, and hypnotics and sedatives drugs in different counties in Norway

Norway is divided into 19 counties (fylke) and has large geographical variation. Counties differ not only by geographically but also socioeconomically and culturally. Different psycho tropical drugs consumption also varies across the counties.

Figure 2: Psychotropic (aggregate three) drug use in different counties in Norway (2011)

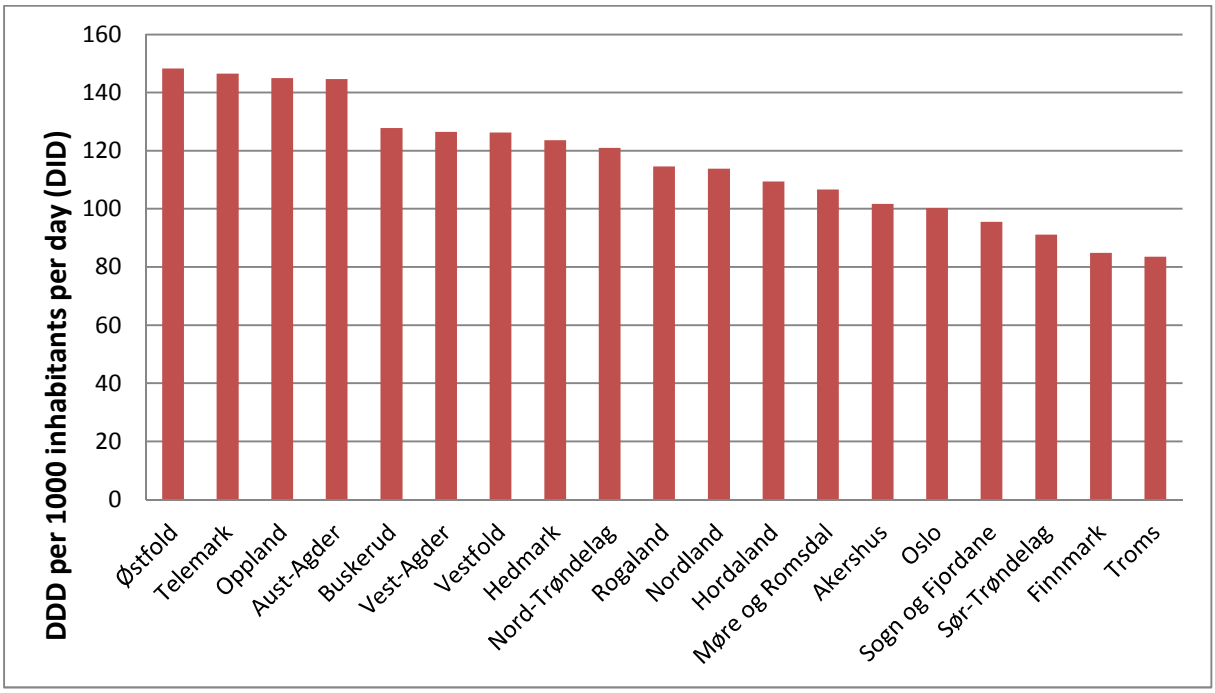


Figure 2 shows the large differences in psychotropic drugs used across counties in Norway according to defined daily dose per 1000 inhabitants per day (DID) in 2011. Relatively high consumption of psychotropic drugs by DID was observed in Østfold, Telemark, Oppland, and Aust agder whereas Troms and Finmark had less consumption among 19 counties. Average consumption of psychotropic drugs by 19 counties were 116.40 DID where greatest consumed by Østfold (148.31) and lowest consumed by Troms (83.6). The difference between highest and lowest consumption was large (almost 66 DID) that ensures a distinct variation across counties with respect to psychotropic drug consumption.

Figure 3: Antidepressants drug use in different counties in Norway (2011)

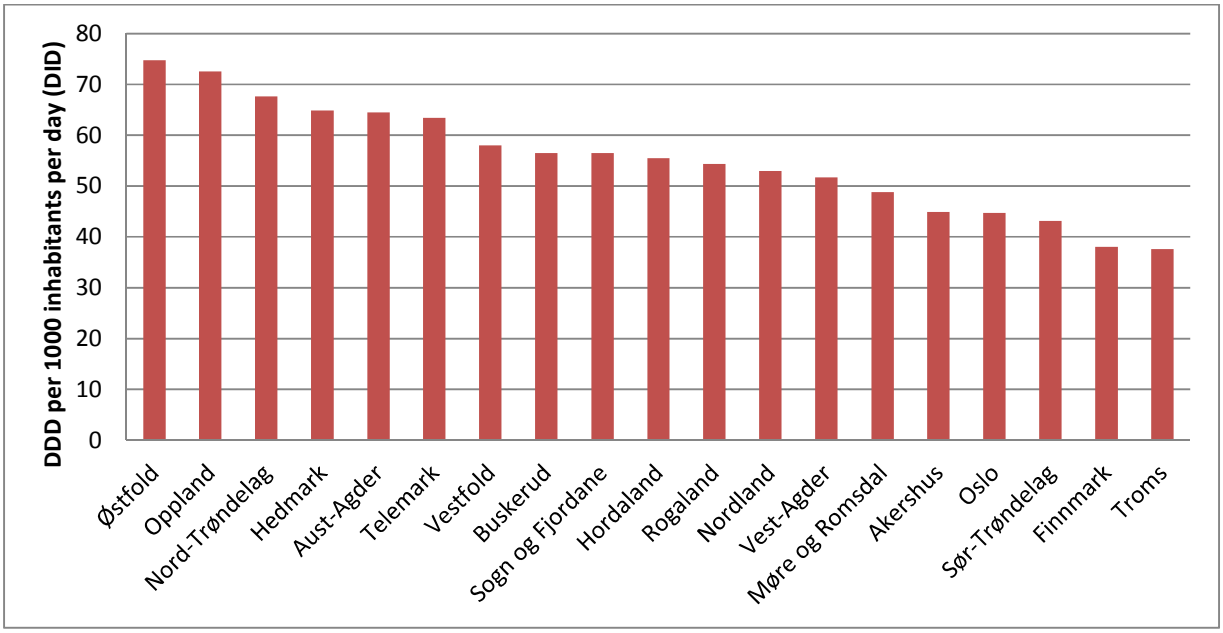


Figure 3 represent the variation of antidepressant drug consumption by different counties in Norway by 2011. The average consumption of antidepressant was 55.28 DID where highest consumption was attained by Østfold (74.79 DID) and lowest consumption attained by Troms (37.60 DID).

Figure 4: Hypnotics and sedatives drug use in different counties in Norway (2011)

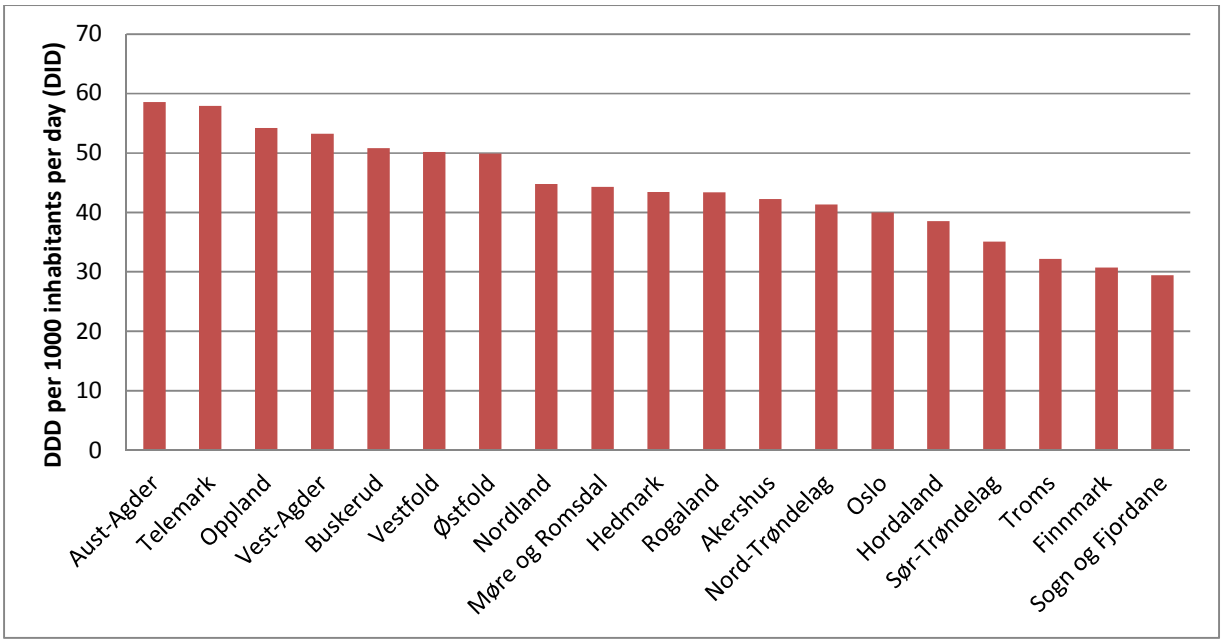
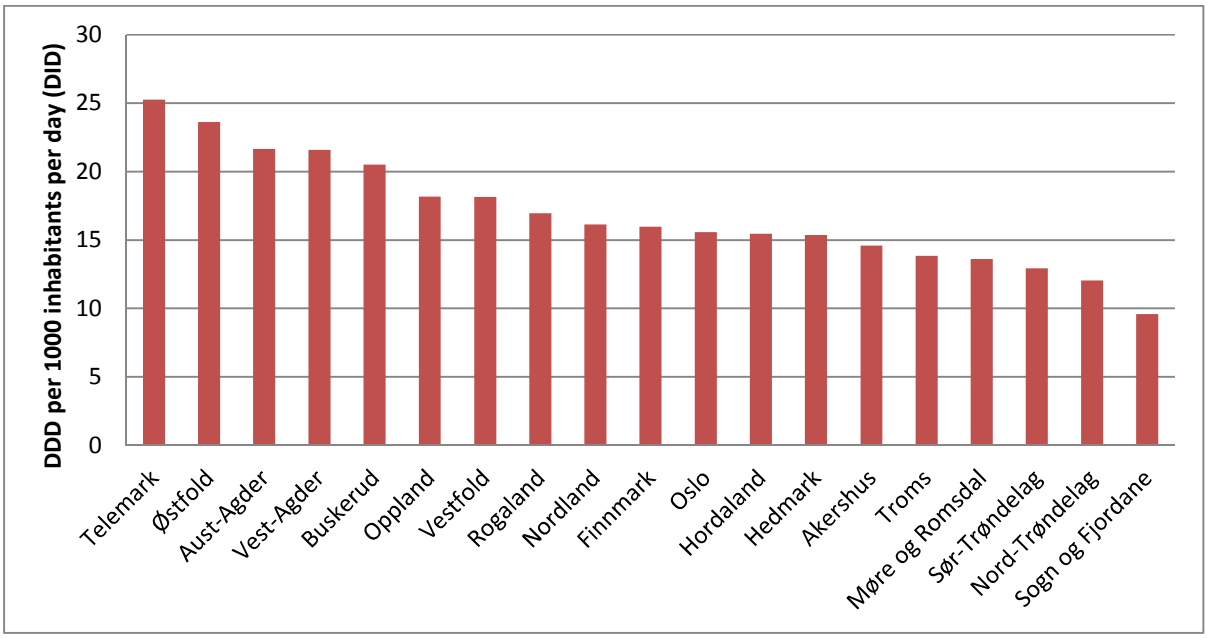


Figure 4 gives a clear idea about the regional variation of hypnotics and sedatives drug use in Norway. Comparing the consumption data in 2011, Aust-Agder was among counties with high consumption rates of hypnotics and sedatives while Sogn og Fjordane had less consumption. Total number of hypnotics and sedatives drug consumption (58.54 DID) in Aust-Agder was almost 99% higher than the consumption (29.43 DID) by Sogn og Fjordane.

Figure 5: Anxiolytics drug use in different counties in Norway (2011)



Looking at the consumption structure of anxiolytics, figure 5 suggests that there was a huge variation in anxiolytics consumption between counties in Norway. The lowest consumption by Sogn og Fjordane was almost 9.59 DID whereas average consumption by all counties was 16.90 DID in 2011. In contrary highest consumption by Telemark was 25.25 DID which is more than the double of lowest.

Figure 2, 3, 4, and 5 depicted a clear regional variation of psychotropic, antidepressant, anxiolytics, and hypnotics and sedatives drugs consumption in different counties in Norway. In the case of all of these drugs, greatest consumed county had almost the double than that of the lowest consumed county which is a cause of concern.

3 Review of Literature

Bocquier et al. (2008) analyzed the geographic variation of dispensing anxiolytics (AX) and hypnotics (HY) drugs use in southeastern France at the canton level and tried to find out responsible demographic factors and determinants for that kind of variation. They used only one year (2005) data and prevalence of chronic illnesses, GP density (per 100000 persons) and several demographic and socioeconomic factors for analysis. They used the ratio of population who had at least one prescription of AX or HY and number of population who were included in general health insurance fund in 2005. On the other hand individual who had six or more prescriptions were considered as chronic ill. They calculated age adjusted prevalence for men and women separately. In this study social and demographic factors were percentage of population in four age groups less than 20 years, 45-59 years, 60-74 years and 75 or more, percentage of single parent families, percentage of old people living alone, and population density (per km²) and socioeconomic factors were unemployment rate, average annual family income, occupational categories that were divided into managerial and professional employees, office workers, and manual workers, proportion of inadequate housing, and subsidized housing.

To find out the effect of age and gender on prescribing AX-HY drugs they used descriptive statistical analysis where they estimated relationship between chronic use and prescribing AX-HY drugs by the Pearson correlation coefficient. They also calculated the extremal quotient (EQ), the ratio of the highest rate to the lower rate, and the weighted coefficient of variation (COV), the ratio of the standard deviation of the rates (among cantons) to the mean rate (among cantons) weighted by the population in each canton, to measure the variation between different cantons. They also used simple and multiple regression analysis to measure the effect of different potential determinants on age adjusted prevalence of AX-HY drugs use for men and women separately.

From the descriptive analysis they showed that in every age group, prevalence of AX-HY is higher for women than for men, and it increased with age. From the Pearson correlation coefficient chronic illness has high effect for both men and women. By the EQ and COV they showed the statistically significant geographic variation exist in different cantons. Among the different demographic and socioeconomic determinants average family income, unemployment rate, and chronic illness are positively related to the AX-HY dispensing for men. On the other

hand results for women are almost same where with these results percentage of subsidized housing also have positive effect on AX-HY dispensing has.

Kjosavik et al. (2009) used antipsychotics, anxiolytics, hypnotics and antidepressants as psychotropic drug to analyze the use of psychotropic drugs in Norway. Based on 2005 data they used gender and six age groups (less than 20years, 20–39 years, 40–59 years, 60–69 years,70–79 years and 80 years and older) as the explanatory variables. By using descriptive statistical analysis they calculated the positive dependency of psychotropic drugs use with female and age. They concluded that female use more psychotropic drug than male and it increases with age.

Wells et al. (1985) conducted a study within six US cities by self-administered enrollment questionnaire within age of 18 years or older. They used sleeping pill and tranquilizer as psychotropic drug and age, sex, education, race, income, site and marital status as explanatory variables. To calculated the effect of explanatory variables they played multiple and logistics regression analysis for each of two psychotropic variables. They found that Women have used both sleeping pill and tranquilizer more than men and use of these two drugs increased with age. They did not find any statistically significant effect of high income, education level and race on sleeping pills. But the effect of high income level has a positive effect on tranquilizer use. They also found the higher prevalence of taking tranquilizer among more educated persons than lower. On the other hand non-black persons take more tranquilizer than black. Other two factors site and marital status have no significant effects on sleeping pills and tranquilizers use.

Lorant et al. (2007) conducted a study to assess the relationship between socioeconomic status and common mental problem, depression, by using seven year periods. For the socioeconomic status they considered three measures that are social relationship, skills, and material standard of living. They assessed the social relationship by living arrangements and civic participation where unemployment and educational status used as skills. They also considered subjective financial strain, deprivation, income, and poverty to measure the material standard of living. To estimate the effect they used fixed effect model. They also used conditional logistic regression for binary response as equivalent of fixed effect model. By using probit model they calculated inverse Mills ratio to correct the selection bias,(loss to follow up could result in bias if poor people and those with depression are more likely to be lost to follow-up than those who are well off and not depressed), from the model and used it an additional explanatory variable in the model. After

that they used Heckman selection model for the panel data fixed effect model. From the study they found a positive effect of increased financial strain, poverty, and deprivation on depression. They also found a negative relationship between depression and living with partner or spouse, and civic participation. But they did not find any statistically significant effect of unemployment and household income on depression.

Kaplan et al. (1987) analyzed the epidemiology of depression by using seventeen explanatory variables within four groups such as status attributes, personal resources, life stress, and physical health. Status attributes included marital status, age, ethnicity, sex, income, and education while personal resources measured by health behavior (alcohol consumption, smoking, usual sleep patterns, physical activity in leisure time), personal uncertainty, anomy, and social isolation and physical disability or presence of chronic conditions. Other group life stress measured by residential move, divorce or separation, death of partner or spouse, money problems, and loss of a job. Ailments, symptoms, and health condition represented the physical health. They used multiple logistic regression models and found that depression symptoms are strongly related with anomy, job loss, physical disability or presence of chronic conditions, social isolation, low education, personal uncertainty, money problem, residential move and baseline depressive symptoms. But baseline health practices, divorce or separation, age, marital status, ethnicity and low income were not associated with symptoms of depression.

Isacson and Haglund (1988) conducted a study on Swedish community to discover the relationship between psychotropic drugs use and socioeconomic and demographic risk factors. By the using of descriptive statistical and multivariate logistic analysis they found that distance to the health center, socioeconomic status, gender , marital status, and age have significant effect of psychotropic drugs use. They showed that psychotropic drugs use is positively associated with increased age, short (less than 5 km) distance of health care, female than male and divorced person than married person.

Colman et al. (2008) conducted a study on a group of population over seventeen years to explore the risk factors of antidepressant, anxiolytic, and hypnotic. They used clinical and non-clinical factors that are associated with these three psychotropic drugs use. Non clinical factors measured by socio demographic factors (sex, living alone, marital status, employment status) and clinical factors measured by poor physical health, sleep difficulties, suicidal ideation and history of

psychiatric symptoms. By using logistic analysis they found strong association between antidepressant, anxiolytic, and hypnotic drug use and clinical factors. On the other hand antidepressant, anxiolytic, and hypnotic drug use is less consistently associated with non-clinical factors.

Lund et al. (2010) tried to find out the association of common mental disorders (CMD) with the level of poverty in low and middle income countries (LMIC). In their research study they have used depression, anxiety and somatoform disorders as common mental disorders and they also have used some exposure variables that are employment status, income, education, social class and socio-economic status (SES), financial stress, housing and living environment (structural), consumption, water and sanitation, housing and living environment (overcrowding), and food insecurity to measure the poverty. They reviewed total 115 previous related literatures from last 19 years. They found a positive association between CMD and poverty where such variables education, financial stress, housing, socio-economic status, social class and food insecurity are strongly related with CMD. Other variables such as employment status, consumption and income are ambiguous.

From reviewed of literatures we found some socioeconomic variables, disable persons, level of education, ethnicity, average income level, density of general practitioner (GP), living alone, smoking habit, unemployment rate, married person, and different age groups, have effect on different psychotropic drugs use and these factors are also appropriate for our study. Besides these responsible factors we also considered some other factors, average temperature, average precipitation rate, population density, and social assistance, as dependable factors for psychotropic drugs use in this study.

4 Data and Methodology

4.1 Data sources and description of variables:

This study was formulated by secondary data collected from the different sources. Total drugs consumption data were taken and constructed from the Norwegian prescription database (on-line database). Temperature and precipitation data collected from Norwegian meteorological institute. Other variables disability, level of education, ethnicity, income, density of general practitioner (GP), population density, living alone, smoking, unemployment rate, married person, social assistance, and different age groups were collected from the Statistics Norway.

In this study we dealt with three types of drugs, antidepressant, anxiolytics and hypnotics from central nervous system (CNS). We used these three types of drugs separately and we also used aggregate value of these drugs for the term psychotropic drug in this research. Anxiolytics, hypnotics and antidepressants, these three categories of drugs explained by the Anatomical Therapeutic Chemical (ATC) codes N05B, N05C and N06A respectively.

The Anatomical Therapeutic Chemical (ATC) drug classification system is the most acceptable drug classification system in the research of drug utilization (Vlahovic´-Palcˇevski et al. 2010) and it also widely used and most useful method in drug consumption research for classifying therapeutic substances into classes (Hutchinson et al.2004). World Health Organization (WHO) recommended this drug classification for the global use. The drug measurement unit Defined Daily Dose (DDD) is integrated with ATC classification system. ``The DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults. This is a technical unit of measurement, not a standard for appropriate use, and it does not necessarily reflect the actual daily dosage most commonly used in a country`` (Vlahovic´-Palcˇevski et al. 2010) (WHO Collaborating Centre for Drug Statistics Methodology). We have used defined daily dose (DDD) per 1000 inhabitants per day to measure the drugs consumption.

Short descriptions of different independent variables are as follows:

Temperature: Average temperature in a calendar year in degree Celsius.

Precipitation: Total precipitation in a year in liter.

Disability: Percentage of population (18-67 years) who receive disability pension.

Level of education: Percentage of population who have at least higher secondary education.

Ethnicity: Percentage of population who are Immigrants and Norwegian-born to immigrant parents.

Income: Average gross income in a year.

Density of general practitioner (GP): Number of GP per 10000 inhabitants.

Population density: Number of population per km^2.

Living alone: Percentage of population who lives alone.

Smoking: Percentage of population (16-74 years) who smoke daily.

Unemployment rate: Percentage of population who are unemployed.

Married person: Percentage of population (18+ years) who are married.

Social assistance: Percentage of population (16-67 years) who receive social assistance.

Age groups: In this study total population is divided into six groups that are age group 0-24, age group 25-34, age group 35-44, age group 45-69, age group 70-79, and age group 80+. Every group measured by the percentage of total population. This study used age group 0-24 as reference group.

4.2 Empirical model:

In this research we used a simple econometric model to examine the relationship between responsible factors and psychotropic drugs consumption. In other words, the model has been used to test the hypothesis whether these factors are responsible for regional variation of psychotropic drugs use or not.

We defined a consumption function for psychotropic drugs use in Norway, which depended on average temperature, average precipitation rate, disability rate, level of education, ethnicity, average income level, density of general practitioner (GP), population density, living alone,

smoking habit, unemployment rate, married person, social assistance and different age groups (age group 0-24, age group 25-34, age group 35-44, age group 45-69, age group 70-79, age group 80+). Both supply side and demand side factors are included in our consumption function.

In our study the counties considered as unit of analysis. The consumption function of psychotropic drugs use is following:

$DR_{it} = f(TE_{it}, PRC_{it}, DI_{it}, ED_{it}, EI_{it}, I_{it}, GPD_{it}, PD_{it}, LA_{it}, SM_{it}, UR_{it}, MP_{it}, SA_{it}, AG2_{it}, AG3_{it}, AG4_{it}, AG5_{it}, AG6_{it}, C_i)$

Where DR_{it} is the psychotropic drugs use in county i and year t, TE_{it} is the average temperature, PR_{it} is the precipitation rate, DI_{it} is the disability persons, ED_{it} indicates the level of education, EI_{it} is the ethnicity, I_{it} is the average income, GPD_{it} is the density of general practitioner (GP), PD_{it} is the population density, LA_{it} is the people who living alone, SM_{it} is the smoking habits, UR_{it} is the unemployment rate, MP_{it} indicate the married person, SA_{it} represent the persons who takes social assistance, $AG1_{it}$ represent the age group 0-24, $AG2_{it}$ represent the age group 25-34, $AG3_{it}$ represent the age group 35-44, $AG4_{it}$ represent the age group 45-69, $AG5_{it}$ represents the age group 70-79, $AG6_{it}$ represents the age group 80+ and C_{it} is the dummy variables for counties.

In our study we used log linear model that are as follows:

$$\ln DR_{it} = \alpha + \beta_1 TE_{it} + \beta_2 PRC_{it} + \beta_3 DI_{it} + \beta_4 ED_{it} + \beta_5 EI_{it} + \beta_6 I_{it} + \beta_7 GPD_{it} + \beta_8 PD_{it} + \beta_9 LA_{it} + \beta_{10} SM_{it} + \beta_{11} UR_{it} + \beta_{12} MP_{it} + \beta_{13} SA_{it} + \beta_{14} AG2_{it} + \beta_{15} AG3_{it} + \beta_{16} AG4_{it} + \beta_{17} AG5_{it} + \beta_{18} AG6_{it} + \sum_{k=19}^{36} \beta_k C_i + U_{it}$$

Where C is the counties (where i = 1,2,……..,19.) and U_{it} is error term. Here ln() is the natural logarithm.

To assess the models that deal with over time cross sectional data (panel data) literatures can provide us various types of econometric models, but the main two most useful and popular methods are random effect and fixed effect model. Our data set contains relatively small number of time periods than cross sectional units that confirm us that we have panel data set and we can precede with fixed or random effect models. To choose the appropriate econometric model between fixed and random effect models we used the Hausman test.

4.3 The Hausman test:

The Hausman specification test provides a clear idea which model should be used, random effect or fixed effect model. The main assumption of random effect model is that there is no significant relationship between time invariant variables with time variant explanatory variables that means independent variables and unobserved effects are not correlated. Hausman specification test identify whether the assumption is violated or not. If the assumption is true that no relationship between independent variables and unobserved effect, then the random effect estimator is more efficient than fixed effect estimator. On the other hand, if the assumption is violated random effect model provide inconsistence estimate of coefficient β and fixed effect model would be the best choice.

Under null hypothesis, there is no correlation, Hausman specification test is a measure of the difference of two estimates. Hausman test statistics H is as follows:

$$\mathbf{H = (\hat{\beta}_{RE} - \hat{\beta}_{FE})' [Var (\hat{\beta}_{FE}) - Var (\hat{\beta}_{RE})]^{-1} (\hat{\beta}_{RE} - \hat{\beta}_{FE})}$$

Where $\hat{\beta}_{FE}$ is coefficient estimate of fixed effect model and $\hat{\beta}_{RE}$ is coefficient estimate of random effect model.

The Hausman test is a chi-square test and H is a distributed chi-square with (k-1) degrees of freedoms where K is number of regressors in the model. If the P- value less than .05, we reject the null hypothesis that told us the two models are different and we have to run the fixed effect model.

4.4 Fixed effect model:

Fixed effect model consider the case that the unobservable explanatory (latent time invariant) variable are correlated with observable explanatory (latent time variant) while random effect model assume no relationship between time invariant and time variant independent variables. Fixed effect model provide unbiased estimate by controlling all time invariant explanatory variables that are correlated with time varying explanatory variables.

Let we consider a panel data set where we have data for a dependent variable, Y and three independent (explanatory) variables, $X_{1,}$ $X_{2,}$ and X_3 that are observable. Total time periods of this

data set are T and total units are N that shows N times T observations. By this data set we developed a relationship between dependent variable and independent variables that consists observable and unobservable explanatory variables. So the fixed effect model is:

$Y_{it} = \beta_0 + \beta_1 X_{it1} + \beta_2 X_{it2} + \beta_3 X_{it3} + u_{it}$

Where i = 1, 2, …, N and t = 1, 2, …, t

E (u_{it}) = 0 and Var $u_{it} = \sigma^2$, that shows i.i.d. (independent random variables).

In model, Y_{it} shows the value of Y for the *ith* unit for the *tth* time period where $X_{it1,}$ X_{it1} and X_{it1} represent the value of $X_{1,}$ X_2 and X_3 for the *ith* unit for the *tth* time period respectively. Error tem μ_{it} shows the μfor the *ith* unit for the *tth* time period.

The least squares dummy variable estimator:

We can use least squares dummy variable estimator as fixed effect estimator. In that case we have to create dummy variables for the units. Here we use total N-1 dummies for N units. These dummy variables defined as follows:

$$D_{kit} = 0 \qquad \text{if } k \neq i$$

$$D_{kit} = 1 \qquad \text{if } k = i$$

We can include these dummy variables in our model as independent variables. Now the new model will be as follows:

$Y_{it} = \beta_0 + \beta_1 X_{it1} + \beta_2 X_{it2} + \beta_3 X_{it3} + \alpha_1 D_{1it} + \alpha_2 D_{2it} + \ldots + \alpha_n D_{nit} + u_{it}$

Where, i = 1, 2, …, N and t = 1, 2, …, t

That model follows that Ordinary Least Square (OLS) estimator.

5 Results

5.1 Hausman test:

This study conducted Hausman test to determine whether random effect or fixed effect model performed adequately for different drugs categories psychotropic, antidepressant, anxiolytics, and hypnotics and sedatives drugs separately. The Hausman test follows chi-square test and the value of chi-square tests are $T_{Hausman}$= 783.96 for psychotropic drug, $T_{Hausman}$= 590.14 for antidepressant drug, $T_{Hausman}$= 245.41 for anxiolytics drug, and $T_{Hausman}$= 217.83 for hypnoticsand sedatives drug. All of the results are significant ($p < 0.05$) and reject null hypothesis, there is no significant relationship between time invariant variables with time variant explanatory variables, it indicates the fixed effect model were preferred for this study.

Table 2: Parameter estimates for four fixed effect model of different psychotropic drugs use in Norway

	Psychotropic		Antidepressant		Anxiolytics		Hypnotics and sedatives	
	Coefficient	S. error	Coefficient	S. error	Coefficient	S. error	Coefficient	S. error
Temperature	-0.0059	0.0021***	-0.0084	0.0025***	-0.0035	0.0034	0.0021	0.0026
Precipitation	0.0037	0.0057	0.0113	0.0083	-0.0039	0.0112	-0.0026	0.0086
Disability	-0.0027	0.0017	0.0324	0.0082***	-0.0169	0.0111	-0.0323	0.0084***
Education	0.0151	0.0059**	0.0291	0.0082***	0.0045	0.0111	-0.004	0.0084
Ethnicity	-0.0079	0.0031**	0.0029	0.0045	-0.025	0.0061***	-0.0119	0.0046**
Income	0.0265	0.0184	0.0027	0.0256	0.0855	0.0347**	0.0359	0.0264
GP density	-0.0125	0.0069*	0.0079	0.0098	-0.0144	0.0133	-0.0241	0.0101**
Population density	0.0005	0.0002**	0.0006	0.0003*	0.0011	0.0005**	0.0002	0.0003
Smoking	-0.00001	0.0011	0.0012	0.0017	-0.0021	0.0023	-0.0001	0.0017
Unemployment rate	-0.018	0.0041***	-0.0249	0.0060***	-0.0204	0.0082**	-0.0085	0.0062
Married	-0.0004	0.0086	-0.0164	0.0119	0.0692	0.0161***	0.0009	0.0123
Social assistance	0.0321	0.0112***	0.0307	0.0166*	0.0937	0.0225***	0.0048	0.0171
Living alone	0.0107	0.0075	0.0056	0.0103	0.0373	0.0139***	0.0189	0.0106*
Age group 25-34	-0.0031	0.0116	-0.0296	0.0167*	0.0342	0.0227	0.0079	0.0173
Age group 35-44	0.0738	0.0175***	0.0178	0.024	0.1548	0.0326***	0.1468	0.0248***
Age group 45-69	0.0456	0.0098***	-0.0071	0.0142	0.0425	0.0193**	0.1007	0.0147***
Age group 70-79	0.07	0.0197***	0.0689	0.0280**	0.0419	0.038	0.0779	0.0289***
Age group 80+	0.1274	0.0328***	0.0977	0.0478**	0.272	0.0649***	0.1225	0.4938**

Table 3: Parameter estimates of different counties for four fixed effect model of different psychotropic drugs use in Norway

	Psychotropic		Antidepressant		Anxiolytics		Hypnotics and sedatives	
	Coefficient	S. error	Coefficient	S. error	Coefficient	S. error	Coefficient	S. error
Akershus	-0.0829	0.0819	-0.1163	0.129	-0.2297	0.1751	-0.0366	0.1333
Aust-Agder	0.3444	0.0782***	0.1739	0.1122	0.2418	0.1523	0.5522	0.1159***
Buskerud	0.0948	0.0412**	0.0603	0.0631	0.1723	0.0856**	0.0544	0.0652
Finnmark	-0.1018	0.0868	-0.3768	0.1254***	0.7024	0.1702***	-0.1357	0.1296
Hedmark	-0.127	0.0246***	-0.0391	0.0365	-0.2179	0.0495***	-0.2395	0.0377***
Hordaland	0.1193	0.0509**	0.0769	0.0841	0.0432	0.1141	0.1812	0.0869**
Møre og Romsdal	-0.0581	0.0512	-0.1545	0.0807*	-0.2074	0.1095*	0.1084	0.0833
Nordland	-0.0477	0.0398	-0.1789	0.0575***	0.1848	0.0780**	0.0004	0.0594
Nord-Trøndelag	0.0351	0.0492	0.0503	0.0736	-0.0851	0.0999	0.0723	0.076
Oslo	-0.4933	0.3451	-0.9107	0.5108*	-1.0123	0.6932	0.0089	0.5278
Rogaland	0.3568	0.1063***	0.3409	0.1625**	0.0444	0.2205	0.4432	0.1679***
Sogn og Fjordane	-0.1788	0.0573***	-0.0926	0.0922	-0.47	0.1251***	-0.2099	0.0953**
Sør-Trøndelag	-0.1114	0.0403***	-0.2966	0.0605***	0.1356	0.0821	0.0396	0.0625
Telemark	0.1657	0.0306***	-0.0095	0.0412	0.3397	0.0559***	0.2329	0.0426***
Troms	-0.1756	0.0524***	-0.4138	0.0757***	0.4011	0.1027***	-0.1313	0.0782*
Vest-Agder	0.3409	0.0909***	0.0094	0.1312	0.2609	0.178	0.6632	0.1356***
Vestfold	0.0252	0.0389	-0.0977	0.0539*	0.0172	0.0733	0.1267	0.0558**
Østfold	0.2651	0.0502***	0.2664	0.0651***	0.2551	0.0884***	0.1461	0.0673**
Constant	0.1041	0.8799	1.6392	1.2387	-6.9803	1.6811***	-2.2791	1.2799*
R-squared value	0.9964		0.9936		0.9917		0.9937	

Number of observations = 156; Level of significance: * p < 0.10, ** p < 0.05, *** p < 0.01.

5.2 Fixed effect model:

Estimated parameters of four different fixed effect models are summarized in Table 2 and 3. Table 2 contains the estimated parameters of all independent variables except regions while table 3 includes the parameter estimates of different regions. There are no structural differences between four models and all are fixed effect model with same independent variables but only difference within four models are different dependent variables that are psychotropic drug, antidepressant drug, anxiolytics, and hypnotics and sedatives drug.

In our study we used log linear model. To get the value in elasticity we multiplied the coefficient value by the average value of independent values[*].

The responsiveness of psychotropic and antidepressant drugs to the change of average temperature is negative and statistically significant (at 1 percent level) which shows the inverse relationship between drug use and average temperature, meaning that a one percent increase in average temperature will reduce 0.0325 and 0.0462 percent psychotropic and antidepressant drug use respectively.

Disability has positive impact on antidepressant, and negative impact on hypnotics and sedatives drug use and both are statistically significant at 1% level. An increase of disable persons by one percentage point, on average, consumption of antidepressant drug will increase 0.3392% while it will decrease 0.3382% hypnotics and sedatives drug use.

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*Let, we have log linear function:

$\ln Y = a + b\,X \rightarrow \frac{d \ln Y}{d X} = b \rightarrow \frac{d Y}{d X} \cdot \frac{1}{Y} = b$

Obviously, we have to multiply both sides by X to get an elasticity value.

$\frac{d Y}{d X} \cdot \frac{X}{Y} = b\,X$

Here we evaluated X by the mean value, X – bar.

Let, $b\bar{X} = \varepsilon$

So, 1% increase in X will increase Y by ε%.

Higher level of education is positively associated with psychotropic and antidepressant drug use which are statically significant at 5% and 1% respectively. If level of education will increase one percent it increases the psychotropic drug use by 1.0309% and antidepressant drug use by 1.9868%.

Percentage of immigrant (non-Norwegian ethnic groups) people has a negative and significant effect on psychotropic, anxiolytics, and hypnotics and sedatives drug use. Result shows that, an increase in immigrant population by 1%, it will reduce the consumption of psychotropic, anxiolytics, and hypnotics and sedatives drugs by 0.0623%, 0.1973%, and 0.0939% and these effects are statistically significant at 5%, 1%, and 5%, respectively.

The sign of the coefficient of average gross income is positive that shows a positive relationship between average gross income and anxiolytics drug consumption. The level of significance of coefficient is 5%. A 1% increases in income, on average, increase the consumption of anxiolytics drug 0.2688 percentage point.

GP density is negatively associated with psychotropic, and hypnotics and sedatives drug use which confirms the inverse relationship. Study presents that, if GP density increases 1% consumption of psychotropic, and hypnotics and sedatives drugs will decrease 0.1079% and 0.2080% that are statistically significant at 10% and 5% level respectively.

The population density has a positive and significant effect on psychotropic, antidepressant, and anxiolytics drugs consumption. A 1% increase in population density is associated with an increase in psychotropic, antidepressant, and anxiolytics drugs consumption by 0.0448%, 0.0538% and 0.0987% with 5%, 10% and 5% level of significance respectively.

The coefficients of unemployment are negative that shows the inverse relationship between unemployment rate and psychotropic, antidepressant, and anxiolytics drugs consumption and this effect is highly significant at 1% level of significance for psychotropic, and antidepressant drugs, and at 5% level for anxiolytics drug, which confirmed that, one percentage increase in unemployment rate will decrease the psychotropic, antidepressant, and anxiolytics drug by 0.0484%, 0.0669%, and 0.0546%, respectively.

Anxiolytics drug consumption responses positively and significantly to the change of percentage of married persons. This responsiveness is statistically significant at 1% level and it implies a 1% increase in percentage of married person will increase 3.3739% consumption of anxiolytics drug.

Consumption of anxiolytics, and hypnotics and sedatives drugs response positively to change of the percentage of individual who lived alone and it is significant at 1% and 10% level respectively which shows one percentage change in alone persons will increase anxiolytics, and hypnotics and sedatives drugs consumption by 0.6210% and 0.3147%, respectively.

This study also found a positive and significant relation between percentage of population who receive social assistance and psychotropic, antidepressant, and anxiolytics drug consumption. Consumption of these three drugs will increase by 0.1017%, 0.0973%, and 0.2969%, respectively with the increase in one percentage of individual who are taking social assistance.

The effect of age on different drugs consumption was captured by six different age groups that are 0-24, 25-34, 35-44, 45-69, 70-79, and 80+ where age group 0-24 used as reference group. We observed an inverse relationship between age group 25-34 and antidepressant drug consumption which is significant at 10% significance level. It shows that 1% increase in percentage of individual aged 25-34, with respect to percentage of individual aged 0-24, will reduce antidepressant drug consumption by 0.3696%. Age group 35-44 is positively associated with psychotropic, anxiolytics, and hypnotics and sedatives drugs consumption at 1% significant level. An increase of individual aged 35-44 by one percentage point, on average, will increase consumption of psychotropic, anxiolytics, hypnotics and sedatives drugs by 1.0798%, 2.2659%, and 2.1479% respectively. Age group 45-69 also has a significant positive impact on psychotropic, anxiolytics, and hypnotics and sedatives drugs consumption at 1%, 5%, and 1% level of significance. Results shows 1% positive change in age group 45-69 will positively change the consumption of psychotropic, anxiolytics, and hypnotics and sedatives drugs by 1.3581%, 1.2658%, and 2.9991% respectively. The estimated coefficient indicates significant positive relationship between age group 70-79 and psychotropic, antidepressant, and hypnotics and sedatives drugs at 1% significant level which confirms that one percentage increased percentage of individual aged 70-79 is predicted, on average, to increase psychotropic, antidepressant, and hypnotics and sedatives drugs consumption by 0.4482%, 0.4411%, and 0.4987% respectively. The extreme age group 80+ is strongly associated with all types of

psychotropic drugs (anxiolytics, antidepressant, hypnotics and sedatives) individually and aggregately. From the regression results, 1% increase in percentage of individual aged 80+ will increase psychotropic, antidepressant, anxiolytics, and hypnotics and sedatives drugs consumption by 0.6036%, 0.4629%, 1.2887%, and 0.5804% and these results are significant at 1%, 5%, 1%, and 5% level respectively.

This study consider the Oppland as reference county according to geographical and socio demographical situation and shows the effect of other 18 counties, with respect to reference county, on different psychotropic drugs consumption. Psychotropic drug is positively related with counties, Aust-Agder, Buskerud, Hordaland, Rogaland, Telemark, Vest-Agder, and Østfold where Rogaland is the highest consumed county by 36% more consumption than Oppland. Other counties Aust-Agder, Vest-Agder, Østfold, Telemark, Hordaland, and Buskerud consumed 34%, 34%, 27%, 17%, 12%, and 9% more than Oppland respectively. On the other hand psychotropic drug is negatively related with counties Sør-Trøndelag, Hedmark, Troms, and Sogn og Fjordane where these four counties consumed 12%, 13%, 18%, and 18% less than Oppland respectively. Antidepressant drug consumption is inversely and significantly associated with different counties that are Finmark, Møre og Romsdal, Nordland, Oslo, Sør-Trøndelag, Troms, Vestfold where positively and significantly associated with counties, Rogaland, and Østfold. On the other hand Buskerud, Finmark, Nordland, Telemark, Troms, and Østfold counties have positive impact and Hedmark, Møre og Romsdal, and Song og Fjordane counties have negative impact on anxiolytics drug consumption. The responsiveness of hypnotics and sedatives drug consumption to the counties Aust-Agder, Hordaland, Rogaland, Telemark, Vest-Agder, Vestfold, and Østfold are positive while counties Hedmark, Song og Fjordane, and Troms are negative.

6 Discussion

The investigation of regional variation in prescription of psychotropic drugs use may take an important role to formulate efficient drugs use in an effective government intervention. By the use of econometric approach this study provided that there are huge differences in psychotropic drugs use in different counties in Norway and these differences mainly occurred because of different characteristics of different counties (demographical and geographical) and different socioeconomic situations.

Temperature: There are no comparable research studies that deal with temperature and psychotropic drugs to find out the impact of temperature on the use of psychotropic drugs. Higher temperature will reduce antidepressant drug use and finally it also reduces psychotropic drugs use. Norway is a country where average temperature is very low compares to others countries in Europe and rest of the world. In 2011 average temperature was 6.03 degree Celsius in Norway. This low temperature may cause of depression in large number of people. Our study suggests that higher temperature can reduce depression that decreases the use of antidepressant drugs. Our study also showed that psychotropic drugs use decreases with the higher temperature and vise verse.

Age: Most of the previous studies found a positive association between age and psychotropic drugs use and this study replicate the findings of previous studies, showing the prevalence of psychotropic drugs use is significantly increased with higher age group (Bocquier et al. 2008; Paulose-Ram R. et al. 2004; Isacson and Haglund 1988; Rojas et al. 2005). Mental health status declines with age and older persons are more vulnerable to psychological and neurological disorder than younger. As a result they need more health care which is the main reason that works behind the positive association between higher age and psychotropic drugs use. Within three psychotropic drugs, hypnotic (HY) is strongly associated with increasing age than other drugs, which is supported by the several previous studies (Kjosavik et al. 2009; Kassam and Patten, 2006; Blennow et al. 1994; Wells et al.1985; Hollingworth and Siskind 2010). Like other studies this study also showed higher association between Antidepressant use and old age persons (Demyttenaere et al. 2008; Kjosavik et al. 2009; Hansen et al. 2004) but Kaplan et al. (1987) did not find any association of age and symptoms of depression. Our study also showed a

positive relationship between higher age and higher use of anxiolytics drug (Neutel 2005; Demyttenaere et al. 2008; Wellset al.1985; Hollingworth and Siskind 2010).

Income: Reviewed of previous literatures cannot permit us to conclude about the connection of level of income and psychotropic drugs use. Our study did not find any statistically significant association of psychotropic drug use with income that supported by Lorant et al. (2007) and Rojas et al. (2005). But according to Lesen et al. (2010) psychotropic drug use will increase with lower income. Several studies from low and middle income countries also showed that lower income significantly increases the common mental disorders (psychotropic syndrome) (Ludermir and Lewis 2001; Patel et al. 2006). Our study also showed that income has no significant effect on antidepressant and hypnotic dugs (Wells et al. 1985). But Kassam and Patten (2006) demonstrated that hypnotic use will increase with lower income than higher income as like Ohayon (1996) and Paulose-Ram et al. (2004). In contrary Bocquier et al. (2008) confirmed the positive association between higher income and hypnotic drug use. Kaplan et al. (1987) showed that income is not associated with symptoms of depression while higher income will decrease the antidepressant use (Mumford et al. 1996; Hansen et al. 2004). From our study, consumption of anxiolytics increased with higher income that is supported by Bocquier et al. 2008 and Wells et al.1985. The main reason is that higher income creates higher health care demand. As a result people consume more anxiolytics when income increases. In contrary some studies concluded that lower income increases anxiolytics use (Ohayon 1996; Paulose-Ram et al. 2004; Mumford et al. 1996).

Education: The relationship between level of education and psychotropic drugs use is not clear according to previous literatures while some studies showed positive association of higher education and psychotropic drugs use, other studies found negative association. After the investigation of the effect of higher education on psychotropic drugs, this study concludes the higher use of aggregate psychotropic drugs with the higher education (Andrews et al. 2001). Higher educated persons are more conscious about their health than lower educated persons and they always tried to maintain a good health status. In a developed country where health is one of the core prioritized sector it is easier to take health service when any persons feel to need. Norway is one of the highly developed country and most of the higher educated persons live in a

busy life by engaging different works which are the main causes of high consumption of antidepressant and aggregate psychotropic drugs among the higher educated persons. Studies from low and middle income countries undoubtedly showed the negative association between common mental disorder (psychotropic) and higher education (Ludermir and Lewis 2001; Araya et al. 2001; Patel et al. 2006). Skurtveit et al. (2005) also showed a negative relationship between higher education and psychotropic drug use while Rojas et al. (2005) did not find any statistical significant relationship between psychotropic drugs and education. Our study also confirmed the use of antidepressant drug is higher among the higher educated persons which is consistent with previous study (Blumenthal and Endicott 1996). Some studies mentioned that lower education is one of the main causes of higher antidepressant drug use (Paulose-Ram et al. 2004; Kaplan et al. 1987; Mumford et al. 1996; Demyttenaere et al. 2008) .We did not find any association between education and anxiolytics use. But Neutel (2005) showed the relation of higher education, higher anxiolytics use while other studies (Paulose-Ram et al. 2004; Demyttenaere et al. 2008; Mumford et al. 1996; Wells et al.1985) showed opposite result that is higher education lower prevalence of anxiolytics. In the case of hypnotic use our study did not report any statistical significant association with education which is supported by Wells et al. (1985). But study by Neutel (2005) showed the relation of higher education, higher hypnotic use while other studies (Paulose-Ram et al. 2004; Kassam and Patten, 2006) showed opposite result, higher education lower prevalence of hypnotic.

Unemployment: Perhaps surprisingly, we found negative association between unemployment rate and psychotropic drugs, and separately antidepressant and anxiolytics drugs but we did not find any significant association between hypnotic and unemployment rate. The main cause of this kind of result is lower unemployment rate in Norway. In 2011, average unemployment rate was only 2.67 percent that are quit low and most of the unemployment was temporary unemployment in Norway which can provide a break from hard work and works as relaxation period. Most of the studies about psychotropic, antidepressant, anxiolytics, and hypnotic drugs confirmed the positive association with unemployed persons (Araya et al. 2001; Bocquier et al. 2008; Magrini et al. 1996; Demyttenaere et al. 2008; Blennow et al. 1994; D'Incau et al. 2011; Hansen et al. 2004). But Rojas et al. (2005) and Lorant et al. (2007) did not find any statistical significant relationship between employment status and psychotropic, and antidepressant drugs.

According to Weich and Lewis (1998), the common onset of common mental disorder is financial strain and employment status is not working as the onset of common mental problem but if any common mental problem exists because of financial strain, unemployment situation can increased the duration of episodes.

Ethnicity: We are not able to conclude the effect of ethnicity on the use of psychotropic drugs from the results of previous studies. In our study we found immigrant person (mostly non-white) has less prevalence of psychotropic drug use (Paulose-Ram et al. 2004; Sleath et al. 1998). In Norway, most of the (over 50%) immigrants came from outside of Europe, mainly from Asia and Africa, where family members tried to live together compared to European countries and they tried to share their problem with family members which works against the use of different psychotropic drugs. Opposite result came from a British study (Jenkins et al. 1997) based on household survey. We did not find any statistical significant relationship between ethnicity and antidepressant use which supported by Kaplan et al. (1987). On the other hand Paulose-Ram et al. (2004) and Brown et al. (1995) showed a positive association of antidepressant use with white ethnic. In our study we confirmed that immigrant persons are less associated with anxiolytics, and hypnotic drugs use than others (Paulose-Ram et al. 2004; Neutel 2005; Wells et al.1985; Blazer et al. 2000; Swartz et al. 1991).

Disability: Consistent with previous studies, our study confirmed that antidepressant use is strongly associated with physical disability condition (Kaplan et al. 1987; Sihvo et al. 2008; Hansen et al. 2004; Parikh et al. 1999). The prevalence of depression is high among the disable persons because of their physical condition. We also found a higher prevalence of hypnotic drug use among the disable persons where Blennow et al. (1994) showed the opposite result. In reference to anxiolytics use we did not find any statistical significant relationship between disability condition and anxiolytics use.

GP density: A few studies have demonstrated the relationship between GP density and psychotropic drugs. The results of Kisely et al. (2000) verified the negative effect of GP density on hypnotics use in a situation of 'client centered' system (It is a system where each patient has an identified GP) which is the same as we found from our study. We did not find any statistical significant association between prevalence of antidepressant, and anxiolytics use and GP density

(Bocquier et al. 2008), while a negative association between GP density and aggregate psychotropic drug use confirmed by our study. The main reason of this negative association is that drugs prescription was substituted by the doctor consultations. In an area where GP density is high, GP compete to each other for patients. In that situation GP can provide more consultations instead of drug prescription which decreases the consumption of psychotropic drugs where GP density is high.

Population density: There is no previous research which examined the effect of population density on the use of psychotropic drugs use. We have used population density as a responsible factor for psychotropic drugs use and found positive association of psychotropic drugs use with the population density. Higher density of population will increase the use of antidepressant, anxiolytics, and aggregate psychotropic drugs use. The main cause of high risk of mental disorder is social stress that is likely to occur as a direct consequence of higher population density. People live in crowded area have higher social stress, as a result they consume more psychotropic drugs. But we did not find any statistically significant relation between population density and hypnotics use.

Smoking: Our research has examined the effect of smoking habits on the use of psychotropic drugs use and did not find any statistical significant relationship. But the some of the previous studies have confirmed the positive effect of smoking habits on the use of antidepressant, anxiolytics, hypnotics, and aggregate psychotropic drugs use (Neutel 2005; Tomasson et al. 2007; Skurtveit et al. 2005).

Married person: Reviewed of previous studies have demonstrated contradictory results about the association of psychotropic drugs use with marital status. Our results showed no significant association between aggregate psychotropic drug use and marital status (Rojas et al. 2005). But Lesen et al. (2010) showed that, married persons have lower risk of psychotropic drugs use while opposite results came from Patel et al. (2006). Most of the studies confirmed the significant decreasing antidepressant drug use in married persons than single or others (Lorant et al. 2007; Jenkins et al. 1997; Hansen et al. 2004) whereas Mumford et al. (1996) found increasing antidepressant use in married persons. But in our study we did not find any significant results about the relation of antidepressant drug use and marital status (Kaplan et al. 1987). In reference of anxiolytics, our study showed a positive association between anxiolytics use and

married persons (Mumford et al. 1996). The main reason is the high divorce and separation rate in Norway. In 2012, 24346 marriages have constructed while 11094 couples have separated and 9929 marriages have dissolved by divorce (SSB). High number of divorce and separation can create an anxiety among the married persons. A British study (Jenkins et al. 1997) based on household survey and a Canadian study (Kassamand Patten 2006) showed that married persons have lower prevalence of anxiolytics use where Wells et al. (1985) found no association between marital status and anxiolytics use. From our study marital status is not associated with hypnotics use (Wells et al.1985) where Kassamand Patten (2006) confirmed the negative association between hypnotics use and married persons.

Social assistance: To the best of our knowledge, there is no comparable study to examine the effect of social assistance on psychotropic drugs use. We have used social assistance as a predictor of psychotropic drugs use and found a strong effect on drugs consumption. Getting social assistance is positively associated with antidepressant, anxiolytics, and aggregate psychotropic drugs use which confirmed us that prevalence of antidepressant, anxiolytics, and aggregate psychotropic drugs use is higher among the persons who are dependent on government social support. Government provides financial support to the poor people but this support is very limited and it is the only income source of these people. In that situation people can face different mental disorders specially depression and anxiety. As a result prevalence of psychotropic drugs consumption is higher among the people who are dependent on government support. In the case of hypnotics use social assistance has no significant effect.

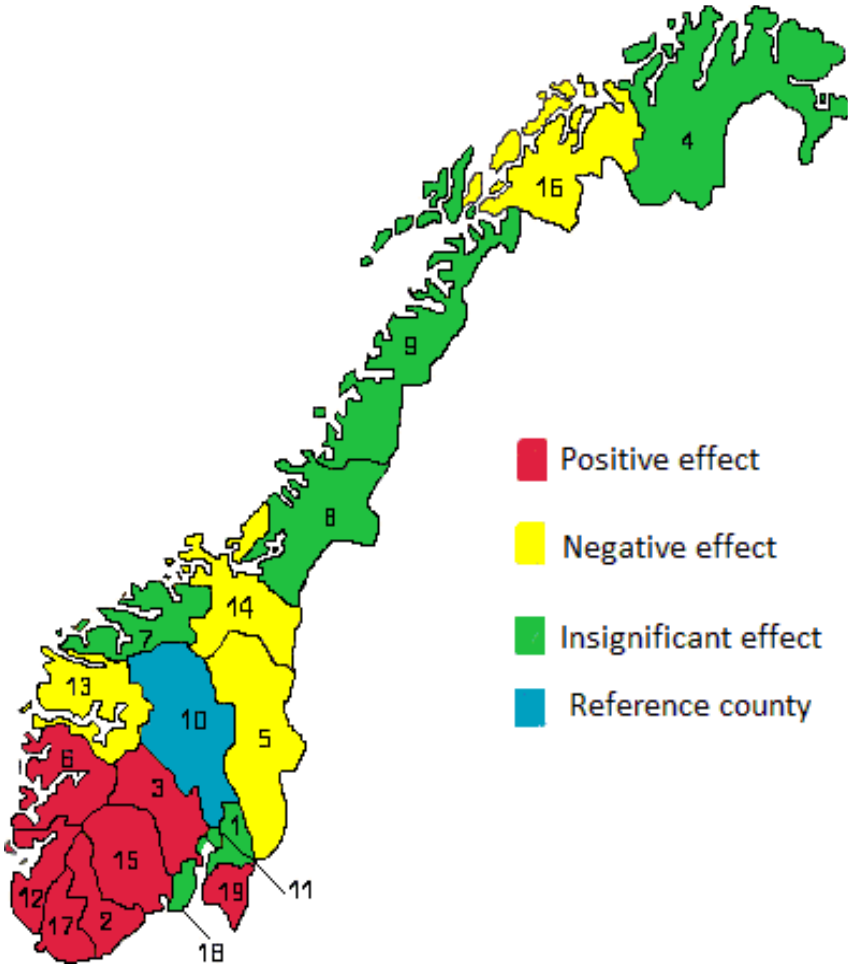
Living alone: Prevalence of anxiolytics and hypnotics drugs use is high among the persons who are isolated from their family and live alone. Living with family members is an important thing for mental health and it can help to keep good mental health. When man lives with his family members he can share his any depressive situation with others and can get help and feel secure. On the other hand, when man lives alone he feels insecure and he can be fall in a mental problem with small things. Our results are supported by Demyttenaere et al. (2008) and D'Incau et al. (2011). In reference of antidepressant and aggregate psychotropic drugs use our study is not able to provide any statistical significant results. But the several studies (Kaplan et al. 1987; Demyttenaere et al. 2008; D'Incau et al. 2011) have good results to show positive association

between social isolation (live alone) and depressive syndrome that increase the use of antidepressant drug.

To estimate the regional variation of psychotropic drugs use in Norway we have considered the county `Oppland` as our reference county. In Norway there are huge differences between counties in reference of geographic, demographic, and socioeconomic situation. We have used graphical information system to show the results from fixed effect model about the variation of psychotropic drugs use between different counties.

To best our knowledge there is no previous studies that deal with the regional variation in prescription of psychotropic drugs use by using econometric analysis and graphical information system. This study is a new addition in this sector. We have illustrated some graphs to show the regional variation in prescription of aggregate psychotropic drugs, antidepressant, anxiolytics, and hypnotics drugs.

Figure 6.1: Regional variation in prescription of aggregate psychotropic drug

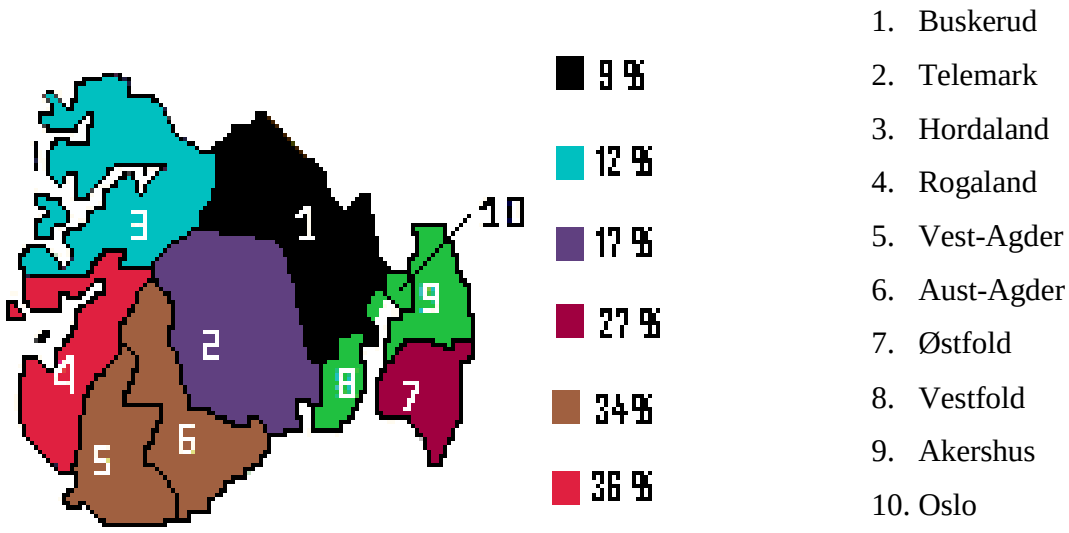


1. Akershus
2. Aust-Agder
3. Buskerud
4. Finmark
5. Hedmark
6. Hordaland
7. Møre og Romsdal
8. Nord-Trøndelag
9. Nordland
10. Oppland
11. Oslo
12. Rogaland
13. Sogn og Fjordane
14. Sør-Trøndelag
15. Telemark
16. Troms
17. Vest-Agder
18. Vestfold
19. Østfold

Figure 6.1 shows the regional variation in prescription of aggregate psychotropic drug in Norway in reference of Oppland county. From figure there are huge differences between counties. We can see that seven counties, Aust-Agder, Buskerud, Hordaland, Rogaland, Telemark, Vest-Agder, and Østfold, have significantly positive effect on aggregate psychotropic drug use than Oppland and all of the seven counties are in south part than Oppland. On the other hand, most of the counties that are situated north side by Oppland have negative effect on aggregate psychotropic drug use but only four counties (Hedmark, Song og Fjordane, Sør-Trøndelag, and Troms) have significant negative effect. This kind of result gives a clear message to us about

regional variation in prescription of aggregate psychotropic drug use. If we follow the color of counties in figure 6.1, where blue shows the reference county, red shows the significant positive effect, yellow shows the significant negative effect, and green shows the insignificant counties, we can easily see that there are clear differences between southern and northern counties by Oppland according to aggregate psychotropic drug use.

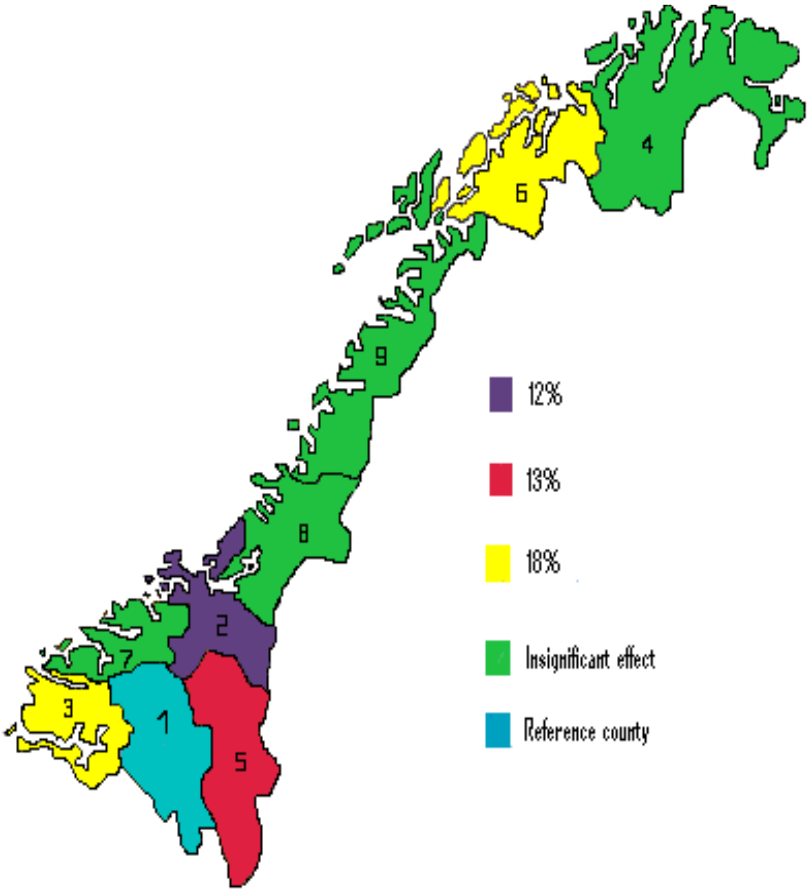
Figure 6.2: Regional variation in prescription of aggregate psychotropic drug within southern part by Oppland county in Norway



1. Buskerud
2. Telemark
3. Hordaland
4. Rogaland
5. Vest-Agder
6. Aust-Agder
7. Østfold
8. Vestfold
9. Akershus
10. Oslo

Figure 6.2 represents the southern part of Norway by Oppland County. All of the colors (except green) showed the positive effect of psychotropic drug use but in different levels. Buskerud have used 9% more psychotropic drug use than Oppland while Hordaland, Telemark, and Østfold have use 12%, 17%, and 27% more respectively. The second highest psychotropic drug used by Aust-Agder and Vest-Agder (34% more than Oppland) follows by highest user Rogaland (36% more than Oppland). We can conclude that, the more we move towards the southern part by Oppland, the more the psychotropic drug use increased.

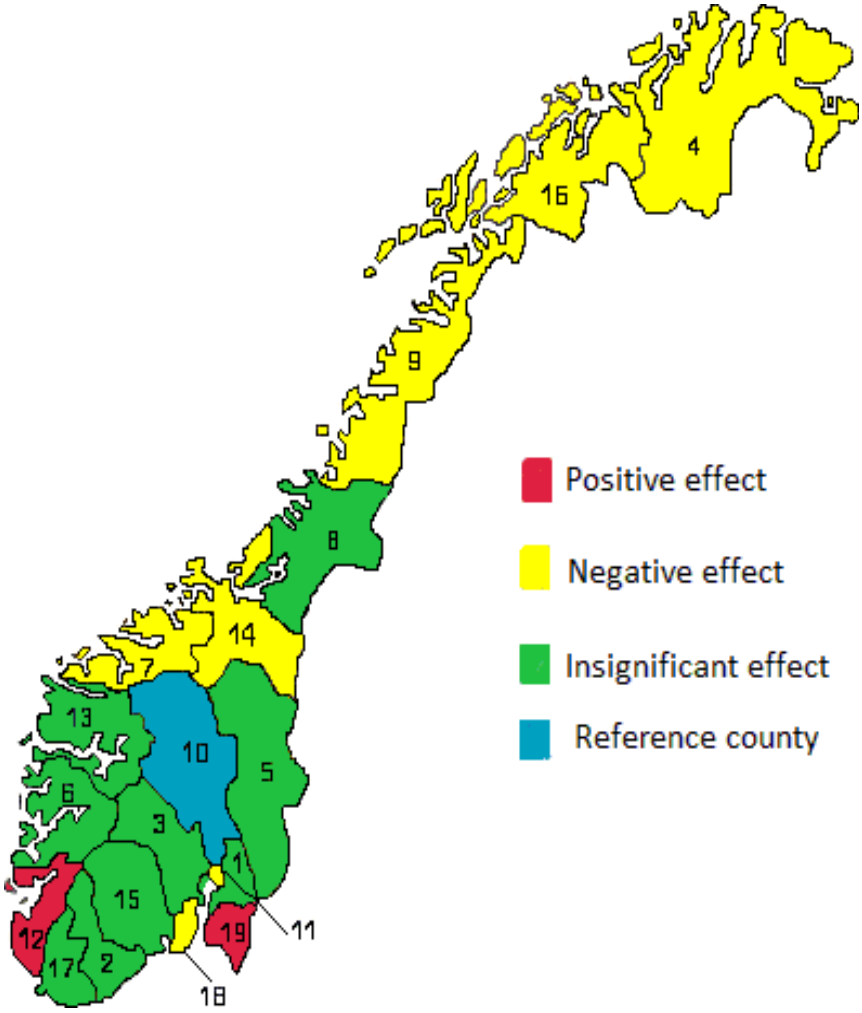
Figure 6.3: Regional variation in prescription of aggregate psychotropic drug within other parts (except southern part) of Norway.



1. Oppland
2. Sør-Trøndelag
3. Sogn og Fjordane
4. Finnmark
5. Hedmark
6. Troms
7. Møre og Romsdal
8. Nord-Trøndelag
9. Nordland

Figure 6.3 shows the other parts of Norway that are not showed in figure 6.2. Blue color represents the reference county Oppland and green color represents the counties which have the insignificant effect. Other three colors show the negative effect on the use of psychotropic drug in different magnitudes. Troms and Sogn og Fjordane used almost 18% less psychotropic drug than Oppland which confirm the lowest consumption of psychotropic drug in Norway. Hedmark consumed 13% less than Oppland while Sør-Trøndelag consumed 12% less than Oppland county.

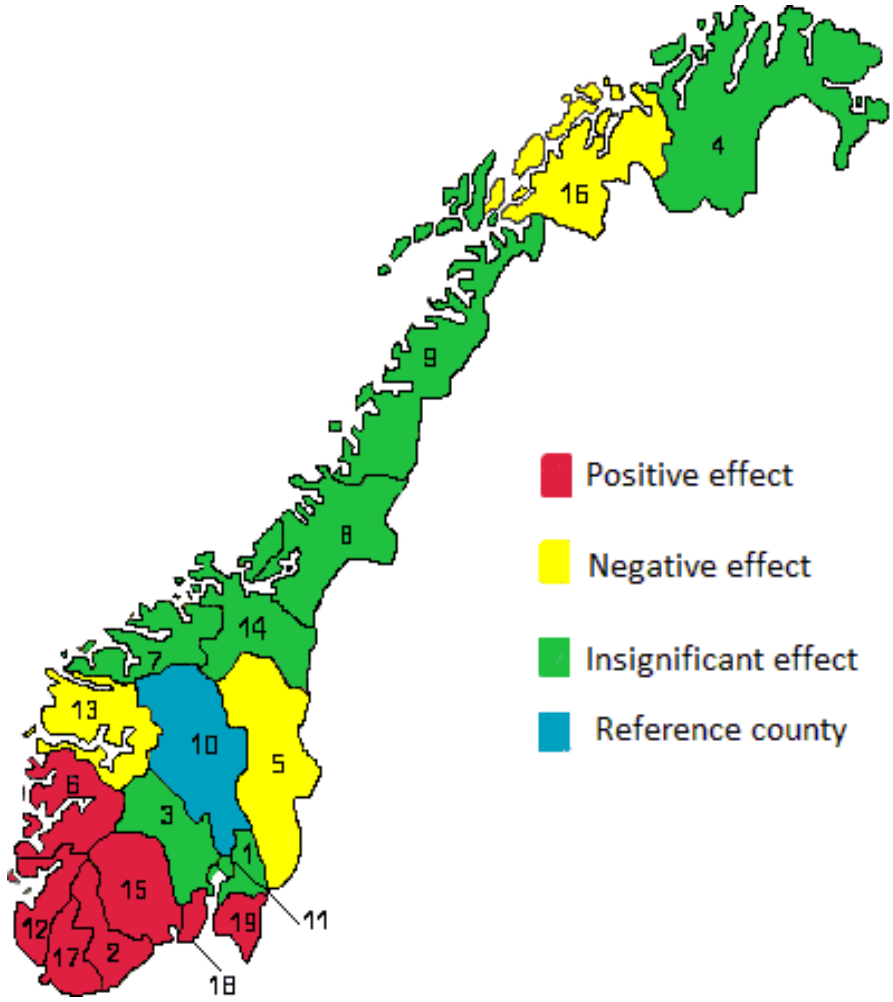
Figure 7: Regional variation in prescription of antidepressant drug



1. Akershus
2. Aust-Agder
3. Buskerud
4. Finmark
5. Hedmark
6. Hordaland
7. Møre og Romsdal
8. Nord-Trøndelag
9. Nordland
10. Oppland
11. Oslo
12. Rogaland
13. Sogn og Fjordane
14. Sør-Trøndelag
15. Telemark
16. Troms
17. Vest-Agder
18. Vestfold
19. Østfold

We demonstrated the variation in prescription of antidepressant drug use between different counties based on Oppland county in Norway in figure 7. Reference county, those have significant positive effect, those have significant negative effect, and those have no significant effect are marked by the four different color, blue, red, yellow, green, respectively. From the figure 7 we conclude that counties north of Oppland have significantly less antidepressant use than southern part.

Figure 8: Regional variation in prescription of hypnotics and sedatives drug

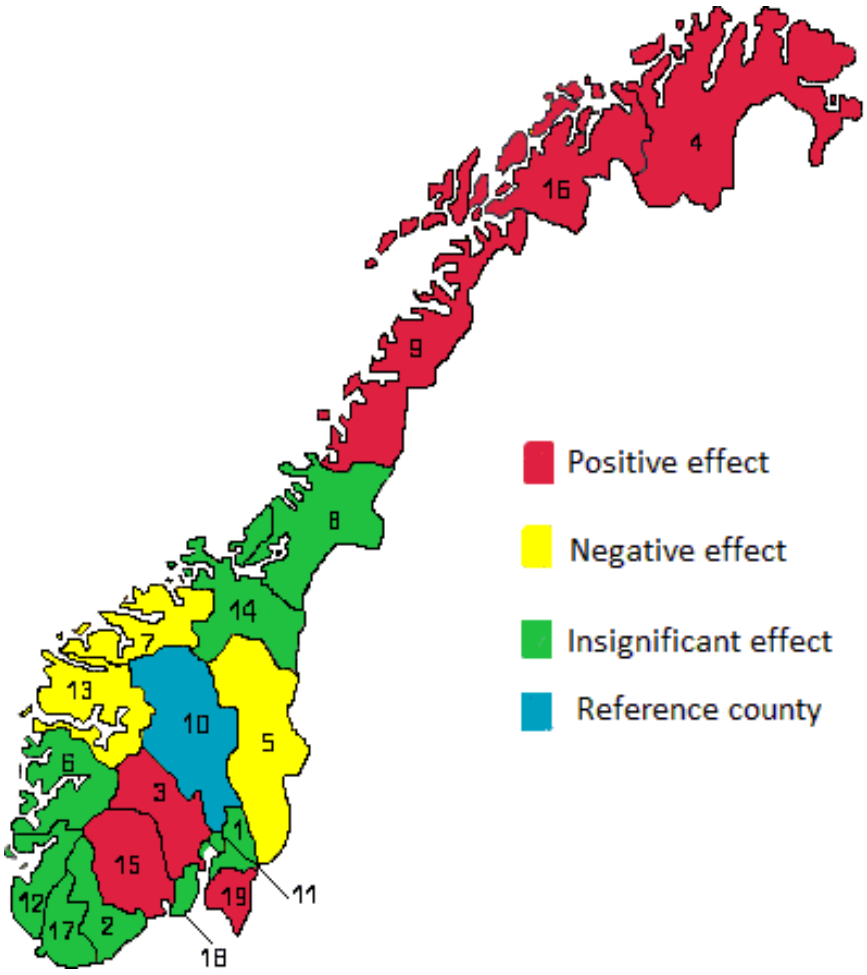


1. Akershus
2. Aust-Agder
3. Buskerud
4. Finmark
5. Hedmark
6. Hordaland
7. Møre og Romsdal
8. Nord-Trøndelag
9. Nordland
10. Oppland
11. Oslo
12. Rogaland
13. Sogn og Fjordane
14. Sør-Trøndelag
15. Telemark
16. Troms
17. Vest-Agder
18. Vestfold
19. Østfold

Southern part has a strong significant positive effect on hypnotics and sedatives drug use in Norway. Most of the counties are from southern part (Aust-Agder, Hordaland, Rogaland, Telemark, Vest-Agder, Vestfold, and Østfold except Buskerud) by Oppland are significantly and positively associated with hypnotics use and colored by the red in figure 8. We also noticed that most of the northern counties by Oppland are statistically insignificant (colored by green) while

three counties (Hedmark, Song og Fjordane, and Troms) have significant negative effect on hypnotics and sedatives use (colored by yellow).

Figure 9: Regional variation in prescription of anxiolytics drug



1. Akershus
2. Aust-Agder
3. Buskerud
4. Finmark
5. Hedmark
6. Hordaland
7. Møre og Romsdal
8. Nord-Trøndelag
9. Nordland
10. Oppland
11. Oslo
12. Rogaland
13. Sogn og Fjordane
14. Sør-Trøndelag
15. Telemark
16. Troms
17. Vest-Agder
18. Vestfold
19. Østfold

We found a little bit opposite results in the case of anxiolytics drug use. Three northern counties of Norway, Finmark, Troms, and Nordland, have significant positive effect on anxiolytics use with other three southern counties, Buskerud, Telemark, and Østfold (marked by red color). On

the other hand shaded by the yellow color three counties, Hedmark, Møre og Romsdal, and Song og Fjordane, showed inverse relationship with anxiolytics drug use.

If we consider figure 7, 8, and 9, we can see that they provided different results to us and we cannot conclude a south north differences but if we take aggregate of psychotropic drugs (total of antidepressant, anxiolytics and hypnotics) (figure 6.1) we conclude a north south difference in drug use. The main cause of these different results is substitution between these three drugs.

In many cases physician recommend antidepressant instead of anxiolytics, and hypnotics for anxiety disorders (Balwin et al. 2005; NICE 2004; Kjosavik 2012) and sleeping disorders (Kjosavik 2012) respectively. According to Gardarsdottir et al. (2007) and Henriksson et al. (2003), symptom of depression is not only factor to use antidepressant, other factors, anxiety, sleeping disorder, also responsible for this. They showed total 45-66% antidepressant have used for depression symptoms where 14-17% for anxiety and 5-9% for sleeping disorder. One Canadian study Patten et al. (2007) showed that physician prescribe almost one third of antidepressant for other reason than depression where Beck et al. (2005) showed 40%. Several studies (Melartin et al. 2005; NICE 2007; American Psychiatric Association 2000) mentioned that large number of antidepressant use terminated within short period whereas Sihvoetal (2008) mention that, the short term user of antidepressant are mainly older than 65 years and sleeping disturbances are the main cause of antidepressant use of them. Other studies (Walsh 2004; Roberts et al. 2000; Ballenger et al. 1999) also found quite frequently use of antidepressant for anxiety and sleeping disorders. In reference of WHO collaborating center for drug statistics methodology, benzodiazepines (N05BA) is the main drug in anxiolytics but it also more usable for sleeping disorders.

7 Conclusion and policy recommendation

To best our knowledge, this is the first study to explore the regional variation in prescription of psychotropic drugs use in Norway. The main objective of this study was to investigate the change in prescription of different psychotropic drugs in different counties in response to change in selective explanatory variables, and counties. By using data from 19 counties over the 8 year periods from 2004-2011, we used a simple fixed effect model to analyze the regional variation in prescription of different psychotropic drugs use. We used consumption of different psychotropic drugs, antidepressant, anxiolytics, hypnotics and sedatives, and aggregate of these three drugs as psychotropic drug, in DDD per 1000 inhabitants per day (DID) as dependent variables and some selective independent variables, temperature, precipitation, disability, level of education, ethnicity, income, density of general practitioner (GP), population density, living alone, smoking, unemployment rate, married person, social assistance, different age groups, and different counties. By using same set of explanatory variables we played four regression analyses for four types of drugs.

In the first model we used consumption of aggregate of three drugs (as psychotropic drug) as dependent variable and found positive influenced by higher education, population density, taking social assistance, age group 35-44, age group 45-69, age group 70-79, and age group 80+ and negatively related with higher temperature, non-Norwegian ethnicity, GP density, and unemployment rate. We estimated second, third, and fourth model by using consumption of antidepressant, anxiolytics, and hypnotics and sedatives drug as dependent variables respectively. We found positive association of disable persons, higher education, population density, taking social assistance, age group 70-79, and age group 80+ and negative association of higher temperature, unemployment rate, and age group 25-34 with the consumption of antidepressant drug whereas consumption of anxiolytics is positively associated with higher income, population density, married persons, receiving social assistance, living alone, age group 35-44, age group 45-69, and age group 80+ and negatively associated with non-Norwegian ethnicity, and unemployment rate. On the other hand, consumption of hypnotics and sedatives drug use has positive relationship with persons who lived alone, age group 35-44, age group 45-69, age group 70-79, and age group 80+ and negative relationship with disable persons, non-Norwegian ethnicity and GP density.

To demonstrate the regional effect on consumption of different psychotropic drugs we used geographical information system (GIS) as a way of explanation and Oppland as reference county. In the case of psychotropic drug (aggregate of three drugs) consumption, we found a clear north south variation by Oppland county. Southern part by Oppland has positive effect on the consumption of psychotropic drug use despite northern part by Oppland has negative or insignificant effect which permit to conclude that southern part by Oppland consume more psychotropic drug than northern part by Oppland in Norway. Moreover when we go through the southern part from Oppland the effect of counties on the consumption of psychotropic drug increased and finally Aust-Agder and Vest-Agder consumed second highest (34% more than Oppland) psychotropic drug after the highest consumed by Rogaland county (36% more than Oppland) .

This study provides a clear message to the government how will be the government intervention to formulate efficient psychotropic drug distribution across the counties in Norway. The southern part by Oppland consumes more psychotropic drugs than northern part which must be considered by government when they will take any intervention.

Limitations of this study:

This study included only the General practitioner (GP) and excluded the specialist doctors because of insufficient data and we did not include the drugs bought from illegal black markets and legal abroad markets. Our main data source NorPD excluded almost 1% prescriptions due to missing data of some variables. This study did not consider patient's compliance as it is unknown and used only dispensed prescriptions by the GP as a proxy of drugs consumptions by patients.

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